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Diseases of Barley

Barley crops are attacked by a number of diseases that are frequently responsible for significant loss of yield. Different diseases can attack the crop from the seedling stage through to crop maturity. The major diseases of barley are parasitic in nature and are caused primarily by fungi, and occasionally by bacteria and viruses. Other diseases are nonparasitic and are caused by environmental factors such as nutrient deficiencies or adverse weather. This information is intended to aid producers in the recognition and management of some common pathogenic diseases of barley. Barley varieties may be **resistant** (little or no disease) **intermediate** (some disease resistance) or **susceptible** to a given disease.

Common root rot and seedling blight

Common root rot is the most important disease of barley in Alberta. Average yield losses are approximately 10 per cent annually and may exceed 40 per cent in severely diseased crops. Yield loss is caused mainly by a decrease in the number of heads per plant and is greatest in dry years when the plants are stressed for moisture. Although common root rot occurs everywhere barley is grown in Alberta, it often goes unnoticed by the producer because the distinctive symptoms develop below ground.

Cause: Several fungi, primarily *Cochliobolus sativus* and *Fusarium* spp.

Symptoms: Small brown lesions develop on the roots, lower leaf sheath, or subcrown internode. Lesions may get larger and grow together causing the entire subcrown to constrict and turn brown or nearly black.

Infected plants may be stunted and lack vigor and show brown discoloration of the crown, stem bases, and leaf sheaths. When infection occurs at the seedling stage, the young plants may be stunted or killed and the disease is then called seedling blight.

Disease cycle: The common root rot fungi attack barley, wheat, and other small grains and are found in soil in all cereal-growing areas of the province. Resting structures of the fungi can survive for years in the soil and remain inactive until a cereal host is available. Spores germinate in the soil and start primary infections on the seedling leaves, roots, and subcrown internode. The root and crown area of infected plants become discolored as the disease progresses.

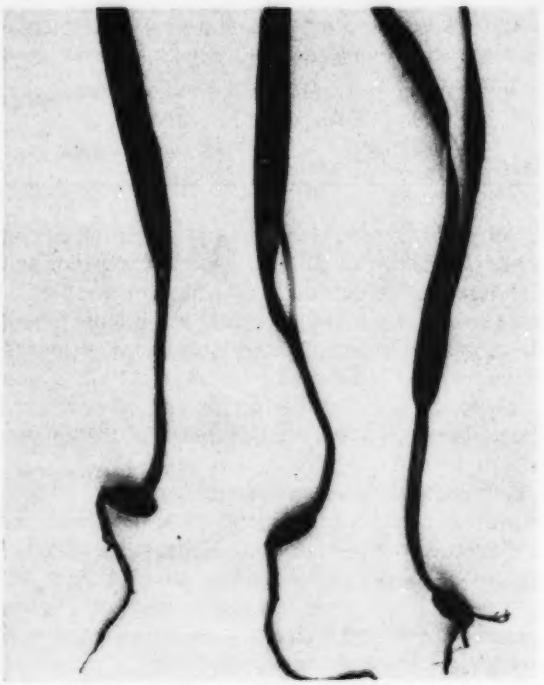

Figure 1. Common root rot on barley.

The fungi produce abundant spores on infected tissues as the plants reach maturity. Common root rot fungi are aggressive pathogens in plants under stress. Drought and warm temperatures are the most important predisposing factors although plants under nutritional stress are also subject to attack.

Cultural control: Shallow seeding (5 cm), when soil moisture conditions are favorable, reduces the risk of infection. Crop rotation with noncereal crops like flax, canola, legumes, and grasses will reduce the number of spores in the soil and help reduce common root rot in the following barley crop.

Resistant varieties: None

Intermediate: Abee, Argyle, Beacon, Bedford, Betzes, Bonanza, Compana, Conquest, Deuce,

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Duke, Ellice, Elrose, Empress, Fairfield, Fergus, Hannchen, Harrington, Heartland, Hector, Herta, Jackson, Johnston, Klages, Klondike, Leduc, Montcalm, Norbert, Palliser, Paragon, Peguis, Samson, Scout, Summit, Tupper, Winchester.

Susceptible: Centennial, Diamond, Galt, Gateway 63, Jubilee, Melvin, Olli, Otal, Windsor.

Chemical control: Seed-treatment fungicides reduce seedling blight caused by these fungi but do not control root rot in seedling plants. Several new experimental fungicides show considerable promise for controlling common root rot.

Scald

Scald is a common leaf disease that develops and spreads best during cool humid weather conditions that occur frequently in June and July in the parkland area of Alberta. Average yield loss to scald in the most recent surveys was estimated at 2.4 per cent, although losses in some fields exceeded 10 per cent. Yield loss is due primarily to a reduction in seed weight, and is proportional to the percentage of leaf area damaged on the top two leaves of the plant.

Cause: A fungus, *Rhynchosporium secalis*.

Symptoms: Scald is easily identified by the distinctive oval shaped lesions that develop on leaves, leaf sheaths, and glumes. The lesions are at first water-soaked and grey-green. These areas dry rapidly and the lesions become light grey and ringed by dark brown margins, a distinctive symptom of this disease.

Disease cycle: The fungus overwinters on diseased crop residue and to a lesser extent with the seed. Spores develop abundantly on diseased stubble during cool wet weather. Spores are dispersed short distances (7 m) by wind and rain-splash and can infect barley at any stage. Spores developing on leaf lesions are responsible for secondary cycles of infection. Wet weather and air temperatures between 15-20°C are ideal for spore production and infection to occur.

Cultural control: When scald is severe, turn under all crop residue and rotate with crops other than brome grass (which is infected by scald).

Resistant varieties: Duke, Johnston, Winchester.

Intermediate: Empress, Leduc, Windsor.

Susceptible: All others.

Net blotch

Net blotch is a disease of the leaves, sheaths, and glumes of barley. It is common wherever barley is grown and is most severe following periods of warm humid weather. Average yield loss in Alberta has been estimated at 1.5 per cent annually, although losses can be much greater in severely diseased crops. Losses in excess of 50 per cent have been recorded with the variety Elrose. Yield loss, like scald, is proportional to the amount of leaf area destroyed on the top two leaves of the plant.

Cause: A fungus, *Pyrenophora teres*.

Symptoms: Typical leaf blotches are light brown at first with an irregular network of dark brown lines that give the blotches their characteristic netted appearance. As the blotches age, the centres become uniformly dark

Figure 2. Scald symptoms on barley.

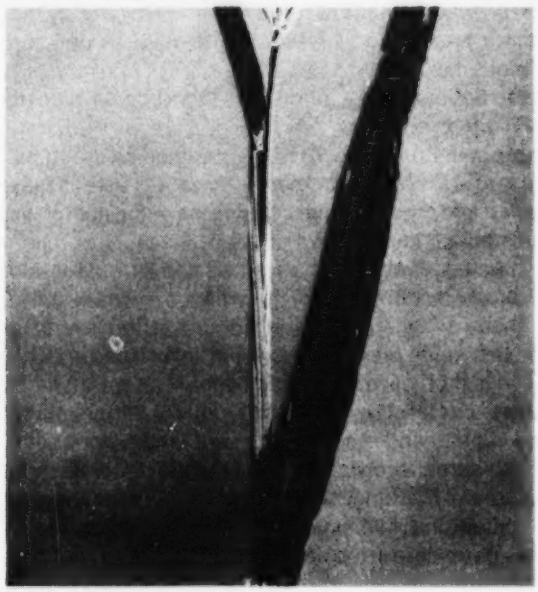

Figure 3. Net blotch of barley.

brown, and the lines forming the net are apparent only at the edges of the lesion. The blotches may enlarge and merge to form dark brown stripes. Occasionally a "spot form" of net blotch occurs in which the lesions appear as small, dark brown roundish spots surrounded by a chlorotic zone. The development of spots depends on the barley variety and the race of the pathogen.

Disease cycle: The net blotch fungus overwinters on the seed or in crop residues in the field. Spores are produced on diseased crop residue during periods of warm humid weather. Infection is greatest when humid conditions persist for 10-30 hours or longer. Air temperatures from 15-25°C are ideal for spore production and infection to occur. Spores produced on leaf blotches are responsible for secondary cycles of infection.

Cultural control: Turning under crop residue reduces the survival of the pathogen. Rotation with other crops for at least two years will reduce the incidence of net blotch. The six-rowed barley varieties generally show less damage from this disease than do the two-rowed varieties.

Resistant varieties: Heartland, Norbert.

Intermediate: Diamond, Ellice, Leduc, Winchester.

Susceptible: All others.

Chemical control: Seed treatment fungicides reduce the chances of introducing new races of the fungus with the seed.

Barley stripe

Barley stripe is a potentially serious disease that, until recently, was almost unknown in Alberta. The appearance of the disease coincided with the introduction of the European variety Summit, which is very susceptible. Infected plants produce little if any seed and yield loss is directly proportional to the percentage of infected plants in the field.

Cause: A fungus, *Pyrenophora graminea*.

Symptoms: Longitudinal yellow stripes appear on the second or third seedling leaf and on most leaves produced after that. The stripes eventually become necrotic and the leaves tend to shred and fray at the ends. Infected plants are usually stunted, and the heads fail to emerge or become twisted, blighted, or compressed.

Disease cycle: The fungus overwinters only in diseased seed. Infection occurs before the seedling emerges from the soil and is greatest when soil temperatures are below 12°C. Infection is much reduced when the soil temperature is above 15°C. The fungus grows systemically within the plant. At the time of heading, spores are produced on infected leaves during periods of high humidity. Spores are dispersed by wind to nearby heads. Seed can become infected at any stage of development, although the most severe infection occurs during the period of early seed development. Infected seeds usually appear healthy.

Figure 4. The effect of barley stripe disease.

Cultural control: Because barley stripe is spread only with diseased seed, the use of pathogen-free seed is the most effective method of control.

Resistant varieties: Abee, Betzes, Bonanza, Diamond, Fairfield, Fergus, Palliser, Scout.

Intermediate: Argyle, Bedford, Conquest, Galt, Gateway, Heartland, Hector, Herta, Klages, Leduc, Melvin, Norbert, Olli.

Susceptible: Beacon, Elrose, Harrington, Johnston, Klondike, Otal, Parkland, Peguis, Summit, Windsor.

True loose smut

In recent years the average loss from loose smut has been close to 1 per cent, but occasionally losses as high as 40 per cent have been reported. Yield loss is directly proportional to the percentage of infected heads. A walk, wearing light clothing, through a newly headed field with 1 per cent or more loose smut, will convince you that this disease is present.

Cause: A fungus, *Ustilago nuda*.

Symptoms: The symptoms of this disease become apparent between heading and maturity. Initially, diseased heads are blackened and clearly visible among newly emerged green, healthy heads. Most infected heads emerge slightly earlier than normal and, except for a delicate membrane, are entirely transformed into a dry, olive-black spore mass. The membrane

ruptures shortly after the heads emerge and the spores are dispersed by wind, leaving only the bare spike.

Disease cycle: The fungus overwinters within the embryo of the barley seed. When infected seed germinates in the spring, the fungus is activated and colonizes the growing point of the plant. As the heads begin to develop, all the tissues except the central spike and a delicate covering membrane are invaded and converted to spores. The spores are mature by the time the infected plant heads out and, following rupture of the delicate membrane, are spread by wind to nearby plants. Infection occurs when spores land on open barley flowers. Following infection the fungus becomes established in the developing seed embryo.

Cultural control

Resistant varieties: None.

Intermediate: Ellice, Leduc, Tupper, Winchester.

Susceptible: All others.

Chemical control: True loose smut can be controlled by using the systemic fungicide, carbathiin. Carbathiin is found in the following commercial seed treatments; Vitavax Powder, Vitavax Solution, Vitavax Dual Powder, and Vitavax Dual Solution.

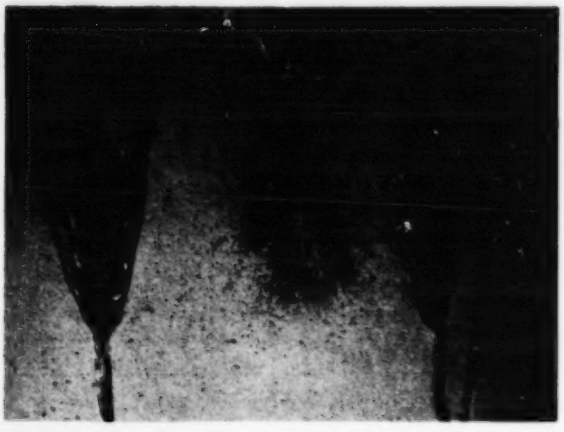

Figure 5. True loose smut in barley

Covered smut and false loose smut

These two diseases, although different in appearance, are discussed together because their disease cycles are method of control are the same. Although both disease can cause serious yield losses, the use of seed treatment fungicides and resistant varieties have limited yield losses to approximately 1 per cent annually.

Cause: Two fungi, *Ustilago hordei* and *U. nigra*.

Symptoms: The symptoms of false loose smut are almost identical to those of true loose smut except for a slight difference in spore color. Distinguishing between these two diseases in the field is not possible. In contrast, covered smut is easily identified by the presence of compact, firm, smutted heads that are enclosed by a persistent membrane. The enclosed spores are not readily blown or washed away by wind and rain and are conspicuous at harvest time.

Disease cycle: Both covered and false loose smut over-winter as seedborne spores. When infested seed is planted in the spring, the smut spores germinate and penetrate the young barley seedlings. The fungi grow with the infected plants until the heads begin to develop. As the barley heads mature the fungi displace all or most of the plant tissues with smut spores. At harvest time the smutted heads are broken and crushed during threshing. The spores collect on the surfaces and in the crevices of barley seed, completing the disease cycle.

Figure 6. Covered smut in barley.

Cultural control:

Resistant varieties: Deuce, Diamond, Galt, Klages, Leduc, Winchester.

Intermediate: Abee, Bedford, Conquest, Duke, Elrose, Fairfield, Fergus, Gateway, Heartland, Hector, Klondike, Melvin, Norbert, Olli, Otal, Samson, Summit, Windsor.

Susceptible: Argyle, Beacon, Betzes, Bonanza, Centennial, Ellice, Empress, Harrington, Jackson, Johnston, Jubilee, Peguis, Scout, Tupper.

Chemical control: Both covered smut and false loose smut can be kept under excellent control with either protective or systemic fungicides. Consult Alberta Agriculture factsheet *Seed Treatment of Cereal and Oilseed Crops* Agdex 100/632 for a complete list of registered seed treatments. If smut was observed in a crop to be used for seed, the grain should be treated. Seed of resistant varieties and seed of susceptible varieties that are free of smut should not normally require treatment.

Barley yellow dwarf

Barley yellow dwarf (BYD) is an aphid-transmitted virus (BYDV) disease that affects barley, wheat, oats, rye, and at least 100 other common species of the grass family. The aphid vectors do not overwinter in Alberta so the virus must be reintroduced each year by wind-blown aphids. The disease usually develops too late in the season to cause significant yield loss. Late-sown spring crops can be severely infected as well as fall cover crops.

Symptoms: Symptoms caused by BYDV are highly variable and often confused with nutrient deficiency and unfavorable growing conditions. In BYDV infected plants, the green tissues of older leaves begin to discolor unevenly along the leaf margins, at the tips, or on the leaf blade in blotches. The blotchy or uneven discoloration the leaf blade is one of the most characteristic symptoms of BYD. The discolored areas enlarge and progress toward the base of the plant. The tissue near the midrib tends to stay green longer than the rest of the leaf. Infected leaves usually turn bright yellow, but the tissue may also turn red or purple. Besides changing color, infected plants are usually stunted; the earlier the infection the more severe the symptoms.

Disease cycle: BYDV is introduced into the cereal crops by migrant aphids. Aphids that acquire BYDV remain infectious for life (about 40 days). Primary infections resulting from the feeding of migrant aphid vectors serve as sources of infection for secondary spread within the crop by the aphid populations multiplying within the field. Epidemics may occur in years when there is a large population of migrant infectious aphids blown in from the south. Cool (10-18°C) moist seasons that favor grass and cereal growth as well as aphid multiplication and migration are ideal for disease development.

Cultural control: Seed early to avoid aphid infestation and damage.

Nonparasitic diseases of barley

Many diseases affect barley that are not caused by living organisms such as fungi or bacteria. These diseases are called nonparasitic. Causes range from nutrient deficiencies or weather induced disorders to herbicide injuries.

Temperature injury (Rugby stocking)

Unusually high or low temperatures in the spring can cause distinct banding of emerging seedling leaves. Both frost or bright hot sunlight can cause repeated white bands called rubgy stocking on the newest part of the leaf to emerge from below ground. Damage may take place over several days. Seedlings generally recover when temperatures improve. Frost of course can cause severe damage to immature grain heads in late summer or early fall. Temperature drops of as little as -1 to -2°C can cause considerable losses. Damage is usually most severe in the lower parts of grain fields where frigid air accumulates.

Chemical injury

Herbicides applied at the incorrect time, herbicide residues from preceding crops and herbicide drift from other crops may cause a range of symptoms from stunting and yellowing to head sterility.

Copper deficiency

Poor barley yields on organic (peaty) soils and occasionally on sandy soils have been linked to a deficiency or low availability of copper. Symptoms of this disease range from leaf yellowing and twisting to premature death of growing plants. Soil applications of copper sulphate have been shown to increase barley yields dramatically in some cases. Control of this problem has not yet been fully researched.

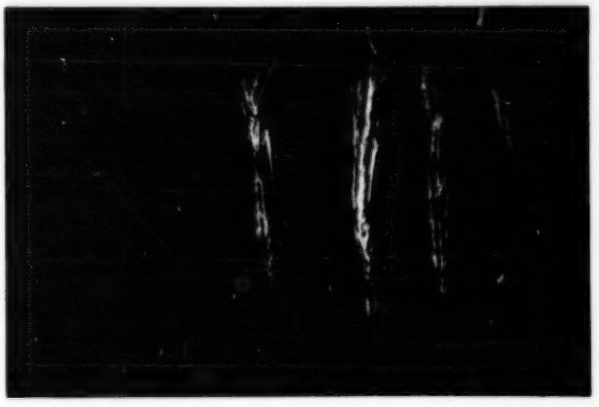

Figure 7. Copper deficiency in barley — sterile grain heads.

Information prepared by:
I.R. Evans,
Crop Protection Branch

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